Spin-axis distribution of the Hungaria asteroids via lightcurve inversion

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Since 2005, we have conducted a dedicated campaign to obtain dense lightcurves of members of the Hungaria asteroid population. As a result, the number of Hungarias in the asteroid lightcurve database (LCDB; Warner et al. [1]) with a statistically valid rotation rate rose from less than 50 to almost 300. The particular value of the Hungarias is that they are smallest and closest-to-sun main belt objects that can be studied with modest-sized telescopes. As such, they are more likely subject to YORP-altered spin states. We have previously verified highly-evolved rotation rates within the Hungarias (Warner et al. [2]). This study takes the next step of tracing the evolution of spin orientations.

We combined the dense lightcurves from our campaign with so-called "sparse data" from the NEA surveys to model the spin axis orientation using lightcurve inversion methods (see works by Kaasalainen, Torppa, Durech, and Hanus). Because high-dispersion sparse data are of little use for low amplitude objects, we limited the Hungarias to be modeled to those with a maximum amplitude of A >= 0.15 mag, an LCDB reliability code of U >= 2, the period in the LCDB summary was unambiguous, and the asteroid did not show signs of tumbling (non-principal axis rotation). The result as of early February 2014 was a list of 227 of Hungaria candidates for modeling.

Using a bank of five independent desktop computers and customized software, we first determined the likely sidereal period of the asteroid. That period was then used for spin axis (pole) search involving 315 discrete longitude-latitude pairs. The result of one such search is shown in the figure. We report on the results of our searches, including weighting solutions when a unique solution was not found (often the case in lightcurve inversion), and how the results compare to similar studies using a more general asteroid population.

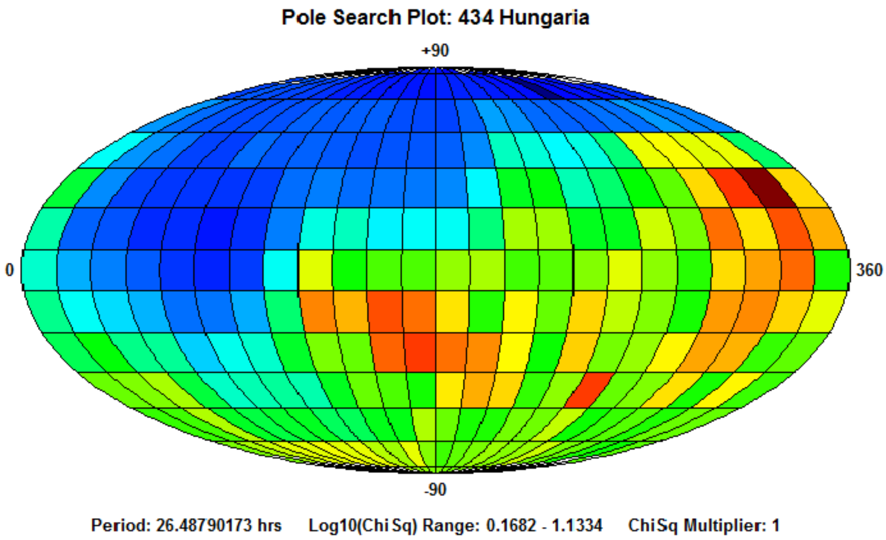

Figure: Pole search plot for 434 Hungaria. Deep blue represents lowest Chi-square while dark red represents the the largest Chi-square solution. This particular solution is not unique but strongly favors a prograde rotation. Warner et al.

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References: [1] Warner, B.D. et al. (2009) Icarus 202, 134-146. [2] Warner, B.D. et al. (2009) Icarus 204, 172-182.